AMENDMENTS TO THE CLAIMS

What is claimed is:

1. (Currently Amended) A method of controlling a brushless dc motor comprising:

commutating the motor under open-loop control based on energizing its windings according to a stored commutation table whose table entries define sequential commutation states for the windings; and

controlling motor speed by setting a selection rate for sequentially selecting the table entries;

wherein the motor comprises an image forming apparatus drive motor, and wherein controlling motor speed by setting a selection rate for sequentially selecting table entries comprises setting the motor speed according to a desired printing process speed.

2. (Original) The method of claim 1, further comprising selecting one of the table entries as a commutation starting point based on positional feedback from the motor.

3. (Original) The method of claim 2, wherein the positional feedback comprises an indication of rotor angle for the motor, and wherein selecting one of the table entries as a commutation starting point based on positional feedback from the motor comprises selecting the table entry corresponding to a commutation state matching the indicated rotor angle.

4. (Original) The method of claim 1, further comprising transitioning from a closed-loop control method based on motor feedback to the open-loop control method based on the stored commutation table as a function of the motor speed.

5. (Original) The method of claim 4, wherein transitioning from a closed-loop control method based on motor feedback to the open-loop control method based on the stored commutation table as a function of motor speed comprises using the closed-loop control method for a first motor speed range and using the open-loop control method for a second motor speed range.

6. (Original) The method of claim 1, further comprising controlling a torque margin of the motor to avoid motor slippage during open-loop control of the motor.

7. (Original) The method of claim 6, wherein controlling a torque margin of the motor to avoid motor slippage during open-loop control of the motor comprises controlling an average winding voltage of the motor to maintain motor torque at a level above expected or measured motor drive loads.

8. (Original) The method of claim 1, further comprising, in a jog mode of motor operation, determining a number of commutation states equal to a desired rotational jog of the motor, and commutating the motor under open-loop control based on selecting that number of table entries from the stored commutation table, and wherein the selection rate is set based on a desired jog speed profile.

9. (Original) The method of claim 8, wherein, in the jog mode of motor operation, the method further comprises determining a starting entry in the table based on positional feedback from the motor.

10. (Original) The method of claim 1, further comprising effecting a desired motor velocity profile based on varying the selection rate according to the desired motor velocity profile.

11. (Canceled)

12. (Canceled)

13. (Currently Amended) The method of claim 1 ~~12~~, further comprising controlling average winding voltages of the motor while commutating the motor under open-loop control to maintain a torque margin for the motor relative to expected or measured image forming apparatus drive loads to avoid motor slippage.

14. (Original) The method of claim 1, further comprising setting an average winding voltage for the motor responsive to closed-loop control of the motor, increasing that average winding voltage by an amount corresponding to a desired torque margin for commutating the motor under open-loop control, and transitioning from the closed-loop control to the open-loop control.

15. (Original) The method of claim 1, wherein the stored commutation table comprise a first set of entries corresponding to a first motor direction and a second set of entries corresponding to a second motor direction, and further comprising sequentially selecting table entries from the first set or the second set depending on a desired motor direction.

16. (Currently Amended) A method of motor control in an image forming apparatus comprising:

driving an image forming subassembly of the image forming apparatus with a brushless dc motor; and

controlling the motor based on open-loop commutation comprising commutating the motor by energizing its windings according to a stored commutation table whose table entries define sequential commutation states for the windings, and controlling motor speed by setting a selection rate for sequentially selecting the table entries;

further comprising starting the motor in the first mode and transitioning to the second mode and selectively operating in either the first mode or the second mode as a function of a desired process speed for the image forming apparatus.

17. (Original) The method of claim 16, wherein controlling the motor based on open-loop commutation comprises determining a starting table entry in the stored commutation table based on a motor feedback signal that indicates motor position.

18. (Original) The method of claim 16, further comprising controlling the motor based on closed-loop commutation in a first mode, and controlling the motor based on the open-loop commutation in a second mode, wherein controlling the motor based on closed-loop commutation comprises commutating the motor under closed-loop control responsive to one or more motor feedback signals.

19. (Canceled)

20. (Currently Amended) The method of claim 16 ~~19~~, further comprising determining an average motor winding voltage used for driving the motor in the first mode, and calculating a higher average motor winding voltage to be used for the second mode based on a torque margin desired for open-loop commutation of the motor.

21. (Canceled)

22. (Currently Amended) The method of claim 16 ~~21~~, wherein selectively operating in either the first mode or the second mode as a function of a desired process speed for the image forming apparatus.

23. (Currently Amended) A motor control circuit for controlling a brushless dc motor comprising:

a logic circuit configured to obtain sequential commutation states for the motor from a stored commutation table whose table entries define sequential commutation states for the windings of the motor; and

an output circuit configured to output commutation signals for commutating motor according to the sequential commutation states;

said logic circuit further configured to control motor speed by setting a selection rate for sequentially selecting table entries;

wherein the motor comprises an image forming apparatus drive motor, and wherein the motor control circuit is configured to control the motor speed as a function of printing process operations.

24. (Original) The motor control circuit of claim 23, wherein the logic circuit is configured to select one of the table entries as a commutation starting point based on positional feedback from the motor.

25. (Original) The motor control circuit of claim 24, further comprising an input circuit configured to receive a feedback signal providing the positional feedback from the motor.

26. (Original) The motor control circuit of claim 24, wherein the positional feedback comprises a indication of rotor angle for the motor, and wherein the logic circuit is configured to select the table entry corresponding to a commutation state matching the indicated rotor angle.

27. (Original) The motor control circuit of claim 23, wherein the motor control circuit is configured to control the motor under closed-loop control based on motor feedback in a first mode of operation, and configured to control the motor under open-loop control based on the stored commutation table in a second mode of operation.

28. (Original) The motor control circuit of claim 23, wherein the motor control circuit is configured to operate in the first mode for a first range of motor speeds, and is configured to operate in the second mode for a second range of motor speeds.

29. (Original) The motor control circuit of claim 23, wherein the motor control circuit is configured to control a torque margin of the motor to avoid motor slippage during open-loop control of the motor.

30. (Original) The motor control circuit of claim 29, wherein the motor control circuit is configured to control the torque margin of the motor by controlling an average winding voltage of the motor to maintain motor torque at a level above expected or measured motor drive loads.

31. (Original) The motor control circuit of claim 23, wherein the motor control circuit is configured to operate in a jog mode of motor operation wherein it determines a number of commutation states equal to a desired rotational jog of the motor, and commutates the motor under open-loop control based on selecting that number of table entries from the stored commutation table, and wherein the motor control circuit controls the selection rate based on a desired jog rate profile.

32. (Original) The motor control circuit of claim 31, wherein, for jog mode operation, the motor control circuit is configured to determine a starting entry in the table based on positional feedback from the motor.

33. (Original) The motor control circuit of claim 23, wherein the motor control circuit is configured to effect a desired motor velocity profile based on varying the selection rate according to the desired motor velocity profile.

34. (Original) The motor control circuit of claim 23, wherein the motor comprises an image forming apparatus drive motor, and wherein the motor control circuit is configured to set the selection rate as a function of printing process requirements of the image forming apparatus.

35. (Canceled)

36. (Original) The motor control circuit of claim 23, wherein the motor control circuit is configured to control average winding voltages of the motor while commutating the motor based on the stored commutation table to maintain a torque margin for the motor relative to expected or measured motor drive loads to avoid motor slippage.

37. (Original) The motor control circuit of claim 36, wherein the motor control circuit is configured to determine a desired average winding voltage for the motor based on a measured drive load and a desired torque margin.

38. (Original) The motor control circuit of claim 36, wherein the motor control circuit is configured to set the average winding voltages based on a desired torque margin relative to estimated motor drive loads.

39. (Original) The motor control circuit of claim 23, wherein the stored commutation table comprise a first set of entries corresponding to a first motor direction and a second set of entries corresponding to a second motor direction, and wherein the motor control circuit is configured to control motor direction by sequentially selecting table entries from the first set or the second set depending on a desired motor direction.

40. (Original) The motor control circuit of claim 23, wherein the motor control circuit comprises a processor circuit configured to execute stored program instructions.

41. (Original) The motor control circuit of claim 23, wherein the motor control circuit comprises at least a portion of an Application Specific Integrated Circuit.

42. (Original) The motor control circuit of claim 23, wherein the motor control circuit comprises at least a portion of a Field Programmable Gate Array.

43. (Currently Amended) An image forming apparatus comprising:

a printer subassembly used in an image forming process of the image forming apparatus;

a brushless dc motor configured to drive the printer subassembly; and

a motor control circuit configured to commutate the motor under open-loop control based on energizing its windings according to a stored commutation table whose table entries define sequential commutation states for the windings;

said motor control circuit configured to control motor speed by setting a selection rate for sequentially selecting table entries;

wherein the motor control circuit is associated with a memory that is configured to store the commutation table.

44. (Original) The image forming apparatus of claim 43, wherein, in a jog mode of operation, the motor control circuit is configured to determine a number of commutation states equal to a desired rotational jog of the motor, and commutate the motor under open-loop control based on selecting that number of table entries from the stored commutation table.

45. (Original) The image forming apparatus of claim 44, wherein the motor control circuit is configured to jog the motor a desired rotational amount in a reverse direction relative to image forming process direction of the motor to relieve binding in the printer subassembly.

46. (Canceled)

47. (Original) The image forming apparatus of claim 43, wherein the motor control circuit is configured to commutate the motor under open-loop control based on the stored commutation table in a first mode of operation, and is configured to commutate the motor under closed-loop control based on a motor feedback signal in a second mode of operation, and wherein the motor control circuit is configured to transition between the first and second modes of operation as a function of motor speed.

48. (Original) The image forming apparatus of claim 47, wherein the motor control circuit is configured to operate in the first mode if a desired motor speed is below a defined threshold, and is configured to operate in the second mode if the desired motor speed is above a defined threshold.